CLAIMS

1.   A method for enhancing an audio signal, comprising:

processing successive portions of the audio signal using a subband filter bank;

applying a nonlinear modification to the output of the subband filter bank for each

5   successive portion of the audio signal to generate a modified subband filter bank output

for each successive portion; and

processing the modified subband filter bank output for each successive portion

using an appropriate synthesis subband filter bank to generate a modified time-domain

audio signal.

10   2.   A method for enhancing an audio signal as recited in claim 1, wherein:

the step of processing successive portions of the audio signal using a subband

filter bank comprises performing the short time Fourier transform (STFT) for successive

portions of the audio signal to obtain an STFT result for each successive portion; and

the step of processing the modified subband filter bank output for each successive

15   portion using an inverse of the subband filter bank comprises performing the inverse

STFT for the modified STFT result for each successive portion to synthesize a modified

time-domain audio signal.

3.   A method for enhancing an audio signal as recited in claim 1, wherein applying a

nonlinear modification comprises enhancing a portion of the audio signal characterized

20   by a rapid change in spectral content.

4.   A method for enhancing an audio signal as recited in claim 3, wherein enhancing

a portion of the audio signal characterized by a rapid change in spectral content

comprises amplifying the spectral magnitude of the portion of the audio signal

characterized by the rapid change in spectral content.

5. A method for enhancing an audio signal as recited in claim 1, wherein applying a nonlinear modification comprises smoothing portions of the audio signal characterized by a rapid change in spectral content.

6. A method for enhancing an audio signal as recited in claim 5, wherein smoothing portions of the audio signal characterized by a rapid change in spectral content comprises reducing the spectral magnitude of the portion of the audio signal characterized by the rapid change in spectral content.

7. A method for enhancing an audio signal as recited in claim 1, wherein applying a nonlinear modification comprises processing the output of the subband filter bank for successive portions of the audio signal using a filter bank.

8. A method for enhancing an audio signal as recited in claim 7, wherein the filter bank is configured to enhance high modulation frequency portions of the audio signal.

9. A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises a linear filter.

10. A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises a set of parallel linear filters and the method further comprises selecting a filter from the set to process each portion of the audio signal based on at least one signal-dependent parameter.

11. A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises a nonlinear filter.

12. A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises a set of parallel nonlinear filters.

13.   A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises an IIR high-shelf filter.

14.   A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises an IIR low-shelf filter.

15.   A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises an FIR sharpener combined with an IIR smoother configured to reduce artifacts.

16.   A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises a nonlinear filter the response of which is determined at least in part by a first time constant.

17.   A method for enhancing an audio signal as recited in claim 16, wherein the value of the first time constant is determined at least in part by a user input.

18.   A method for enhancing an audio signal as recited in claim 7, wherein the filter bank comprises a nonlinear filter the response of which is determined at least in part by a first time constant for portions of the audio signal in which spectral magnitude is increasing and by a second time constant for portions of the audio signal in which spectral magnitude is decreasing.

19.   A method for enhancing an audio signal as recited in claim 1, wherein applying a nonlinear modification comprises determining a modified spectral magnitude for each successive portion of the audio signal.

20.   A method for enhancing an audio signal as recited in claim 19, wherein applying a nonlinear modification further comprises raising the modified spectral magnitude to an

exponent and dividing the result by the corresponding original spectral magnitude to obtain a modification factor.

21.   A method for enhancing an audio signal as recited in claim 20, wherein the value of the exponent is determined at least in part by a user input.

5   22.   A method for enhancing an audio signal as recited in claim 20, wherein applying a nonlinear modification further comprises multiplying the original, unmodified output of the subband filter bank for each successive portion of the audio signal by its corresponding modification factor.

23.   A method for enhancing an audio signal as recited in claim 19, wherein applying
10   a nonlinear modification further comprises calculating a modification ratio equal to the modified spectral magnitude divided by the corresponding original spectral magnitude.

24.   A method for enhancing an audio signal as recited in claim 23, wherein applying a nonlinear modification further comprises raising the modification ratio to an exponent to determine a modification factor.

15   25.   A method for enhancing an audio signal as recited in claim 24, wherein applying a nonlinear modification further comprises multiplying the original, unmodified output of the subband filter bank for each successive portion of the audio signal by its corresponding modification factor.

26.   A method for enhancing an audio signal as recited in claim 1, wherein the step of
20   applying a nonlinear modification to the output of the subband filter bank for each successive portion of the audio signal comprises:

defining a first frequency band; and

determining a modified spectral magnitude for the output of the subband filter bank for said first frequency band; and

using the modified spectral magnitude to determine a modified subband filter bank output for said first frequency band.

5   27.   A method for enhancing an audio signal as recited in claim 26, wherein the step of applying a nonlinear modification to the output of the subband filter bank for each successive portion of the audio signal further comprises:

defining a second frequency band;

determining a modified spectral magnitude for the output of the subband filter
10   bank for said second frequency band;

using the modified spectral magnitude to determine a modified subband filter bank output for said second frequency band; and

combining the modified subband filter bank output for said first frequency band with the modified subband filter bank output for said second frequency band to obtain a
15   combined modified subband filter bank output for the combined frequency range represented by the first and second frequency bands.

28.   A method for enhancing an audio signal as recited in claim 26, further comprising:

defining an arbitrary number of frequency bands;
20   determining a modified spectral magnitude for the output of the subband filter bank for each frequency band;

using the modified spectral magnitude to determine a modified subband filter bank output for each frequency band; and

combining the modified subband filter bank outputs for all of the frequency bands
25   to obtain a combined modified subband filter bank output for the combined frequency range represented by the frequency bands.

29.   A method for enhancing an audio signal as recited in claim 26, wherein the first frequency band is defined by a lower boundary frequency and an upper boundary frequency.

30.   A method for enhancing an audio signal as recited in claim 29, wherein the lower boundary frequency and the upper boundary frequency are fixed parameters.

31.   A method for enhancing an audio signal as recited in claim 29, wherein the lower boundary frequency and the upper boundary frequency are variable parameters.

32.   A method for enhancing an audio signal as recited in claim 31, wherein the lower boundary frequency and the upper boundary frequency are determined at least in part based on an input from a user.

33.   A system for enhancing an audio signal, comprising:

a data input line configured to receive said audio signal; and
a processor configured to:

process successive portions of the audio signal using a subband filter bank;

apply a nonlinear modification to the output of the subband filter bank for each successive portion of the audio signal to generate a modified subband filter bank output for each successive portion; and

process the modified subband filter bank output for each successive portion using an appropriate synthesis subband filter bank to generate a modified time-domain audio signal.

34.   A system for enhancing an audio signal as recited in claim 33, wherein the data input line is configured to receive said audio signal from an external source.

35.   A system for enhancing an audio signal as recited in claim 33, wherein the data input line is configured to receive said audio signal from a storage device.

36.   A system for enhancing an audio signal as recited in claim 33, wherein the data input line is configured to receive said audio signal from a device configured to read a

5   physical medium on which data associated with the audio signal has been stored.

37.   A system for enhancing an audio signal as recited in claim 33, wherein the subband filter bank is configured to perform the short-time Fourier transform on said successive portions of the audio signal.

38.   A computer program product for enhancing an audio signal, the computer

10   program product being embodied in a computer readable medium and comprising computer instructions for:

        processing successive portions of the audio signal using a subband filter bank;

        applying a nonlinear modification to the output of the subband filter bank for each successive portion of the audio signal to generate a modified subband filter bank output

15   for each successive portion; and

        processing the modified subband filter bank output for each successive portion using an appropriate synthesis subband filter bank to generate a modified time-domain audio signal.